Description

CAN END

Technical Field

[001] The present invention relates to a pressurised can and in particular, to an end suitable for use on a pressurised food can. In a pressurised food can, the food product is inserted into the can and stored therein under pressure. The increased pressure in the can is achieved by pressurising the headspace above the food product.

Background Art

[002] Pressurisation of the headspace may be achieved in a number of different ways. For example, a droplet of liquid, inert gas may be inserted into the can prior to sealing with the end, as described in

US 289844 (PABST BREWING COMPANY). --.

). The liquid then evaporates and the resultant gas pressurises the headspace. Alternatively, after sealing, a portion of the can may be irreversible pushed inwardly to similarly pressurise the headspace gases by forced reduction of the volume of the headspace. This technique is described in

EP 0521642 B (CMB FOODCAN). --.

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Disclosure of Invention

[003] The advantage of pressurising a can is that the can may be made of substantially thinner gauge metal, which is deformable under normal conditions. The internal pressure in the pressurised can supports the walls of the can, providing the rigidity required for handling and transport.

[004] However, a can whose contents are held under pressure has the disadvantage that upon first opening, the pressure inside the can is rapidly released to the atmosphere and the stream of released gases may carry a quantity of product. This problem is referred to as “spurting” and is highly undesirable for the consumer. In extreme circumstances, such “spurting” may have explosive force making the can dangerous. The present invention is concerned with mitigating or even eradicating “spurting”, upon first opening of a pressurised can.

[005] Preferably, the volume of the headspace (the fee space between the surface of the product and the can) is minimised. This reduces the volume of pressurised gas released from the can upon first opening. However, the inventors have found that the height of the headspace at the point of first opening (i.e. the point at which the can is exposed to atmospheric pressure) needs to be maximised. The height of the headspace at the point of first opening has been found to be critical in determining whether the can will

"spurt" when opened by a user.

[006] Conventional food cans comprise a hollow body, in which the product is stored, and at least one end, which is connected to the free edge of the body, conventionally by seaming and in particular by a technique known as double seaming. Conventional ends comprise a flat plate-like centre panel connected to a seaming portion (often referred to as the "cover hook") via a chuck wall, which supports a seaming chuck during the double seaming process. At the base of the chuck wall a concave reinforcing bead (looking from the outside of the can) is normally provided, to strengthen the end and support the seam. Conventional can openers first pierce the can at a point adjacent to or lying within the reinforcing bead. Further shallow beads may also be provided on the wall of the can body and/or on the end, to strengthen the can.

[007] Accordingly the invention provides a pressurised can comprising a sealed vessel having an access region at which the sealed vessel is first opened, and a product defining o product surface and a head space, the product confined within the sealed vessel with the headspace arranged in fluid communication with the access region, characterised in that the sealed vessel is adapted to minimise the volume of the headspace, whilst maximising the height of the headspace above the product surface at the access region.

[008] Conventionally, the volume of the headspace in a can is minimised because any volume in the can not used for product is wasteful of space and poorly perceived by consumers. In a pressurised can, the volume of the headspace is particularly important, because this "space" contains the pressurised gas, which pressurises the can and has to be released into the atmosphere on first opening of the can. The inventors have found that the height of the headspace at the point of first opening is particularly important to the spurting properties of the can and should be maximised to reduce the risk of unacceptable spurting. Thus, the design of the can will involve a trade-off between minimising the volume of the headspace for the reasons discussed above and maximising the distance between the surface of the product and the point of first opening of the can, to reduce the chances / level of spurting. This may be achieved by increasing the height of the headspace within an access region, whilst reducing the height/volume of the headspace outside the access region.

[009] Where a can is opened using a conventional can opener or where the can end is a so-called "easy-open end" (i.e. EOLE®), the can is conventionally opened towards the peripheral edge of the can end. In this situation, the central portion of the end may be indented so that it lies closely adjacent to or even touching the surface of the product. This allows the headspace volume to be minimised whilst ensuring that the height of the headspace at the point of first opening is sufficiently large to prevent or at least significantly reduce the level of spurting.

[010] The inventors carried out a number of tests using conventional cans having two different types of end (EOLE® – Easy Open End and NEO – Non-easy Open End), different levels of headspace pressurisation and a height of headspace at the point of first opening of 8mm. A headspace height of 8mm was chosen as a good average of the headspace height provided in most conventional food cans. All tests were carried at an ambient temperature of 25 °C; the filled cans were allowed to stand for at least ½ hour before opening and NEO samples were opened using a Standard Butterfly can opener. The level of spurting from the can upon first opening was recorded by holding a sheet of white paper above the end of the can to catch any splatter of product, which was ejected. This test is referred to as the white glove test (WGT). The test is intended to represent the degree of "spurting" that a user would experience, if opening the can whilst wearing white gloves. The test is considered successful, if the user could open the can, with no marks damaging the gloves. The results of the tests are shown in Table 1 (below).

[011]

Table 1

Can	End Type	Pressure psi (bar)	Headspace Height (mm)	Product	WGT	Comments
1	EOLE	5 (0.34)	8	Water	Fail	Droplets ejected
2	EOLE	5 (0.34)	8	Water	Pass	
3	EOLE	5 (0.34)	8	Water	Pass	
1	EOLE	10 (0.69)	8	Water	Fail	Droplets ejected
2	EOLE	10 (0.69)	8	Water	Fail	Spurt of water
3	EOLE	10 (0.69)	8	Water	Fail	Spurt of water
1	EOLE	15 (1.03)	8	Water	Fail	Big spurt of water
2	EOLE	15 (1.03)	8	Water	Fail	Explosive opening
3	EOLE	15 (1.03)	8	Water	Fail	Big spurt of water
1	NEO	5 (0.34)	8	Water	Pass	
2	NEO	5 (0.34)	8	Water	Fail	Spurt of water
3	NEO	5 (0.34)	8	Water	Fail	Spurt of water
1	NEO	10 (0.69)	8	Water	Pass	
2	NEO	10 (0.69)	8	Water	Fail	Spurt of water
3	NEO	10 (0.69)	8	Water	Fail	Big spurt of water

Can	End Type	Pressure psi (bar)	Headspace Height (mm)	Product	WGT	Comments
1	NEO	15 (1.03)	8	Water	Pass	
2	NEO	15 (1.03)	8	Water	Fail	Big spurt of water
3	As NEO	15 (1.03)	8	Water	Fail	Big spurt of water

[012] As shown by these results, even at the lowest level of pressurisation of 5 psi (0.34 bar) "spurting" is problematic, for both types of ends. At higher levels of pressurisation, "spurting" becomes unacceptable.

[013] The same series of tests were then carried out for a headspace height at point of first opening of 12 mm and headspace pressurisation of 10 psi (0.69 bar) and 15 psi (1.03 bar), again using the same type of conventional cans and ends. The results of these tests are shown in Table 2.

[014]

Table 2

Can	End Type	Pressure psi (bar)	Headspace Height mm	Product	WGT	Comments
1	EOLE	10 (0.69)	12	Water	Pass	No spurt / No water
2	EOLE	10 (0.69)	12	Water	Pass	No spurt / No water
3	EOLE	10 (0.69)	12	Water	Pass	No spurt / No water
1	EOLE	15 (1.03)	12	Water	Pass	No spurt / vapour?
2	EOLE	15 (1.03)	12	Water	Fail	Water ejected
3	EOLE	15 (1.03)	12	Water	Pass	No spurt / No water
1	NEO	10 (0.69)	12	Water	Pass	No spurt / droplets
2	NEO	10 (0.69)	12	Water	Pass	No spurt / droplets
3	NEO	10 (0.69)	12	Water	Pass	No spurt / droplets
1	NEO	15 (1.03)	12	Water	Pass	No spurt / droplets
2	NEO	15 (1.03)	12	Water	Pass	No spurt / droplets
3	NEO	15 (1.03)	12	Water	Pass	No spurt / droplets

[015] By comparison of the results from Tables 1 and 2 above, it can be seen that a headspace height of 12 mm at the access region / point of first opening significantly reduces the level of spurting for both EOLE and NEO ends. As expected, lower pres-

surisation of the headspace results in lower levels of spurting.

[016] This theory works well for liquid products (i.e. water) or products held in a liquid (vegetables in brine, for example), but further problems have been identified with more viscous products (chilli con carne and pet food, for example). When these products are agitated during transport, handling etc. or stored in an inverted position, it takes longer for the product to settle with the headspace in communication with the access region and in some cases this may never occur. In these circumstances, it is likely that at least some product will be retained within the access region, having the larger headspace height at the point of first opening. Consequently containers filled with such viscous products, have been found to spurt upon first opening of the container, despite the can having a maximised headspace height at this point.

[017] In order to gain a better understanding of this phenomenon, a transparent can was filled with various products, to observe the effect of the product on opening of the can. The surface tension of thicker products was observed to cause the product surface to creep up the sidewall of the can, reducing the overall headspace height at the point of first opening.

[018] However, the same surface tension forces of these thicker products can also be used to mitigate this problem, by the careful placement of attraction features within the headspace but outside the access region. If an indentation is provided extending into the headspace of the can, so that it touches or approaches close to the surface of the product, such viscous products will tend to be attracted to the indentation, which acts as an "attraction feature" and draws the product away from the access region, leaving the height of the headspace at the point of first opening largely unobstructed.

[019] Furthermore, the meniscus formed on the surface of a the product has been found to make a "meniscus jump" toward such attraction features, even when they are not in contact with the product surface. Thus, the attraction feature will still draw product away from the access region, increasing the headspace height in this region, providing that it extends far enough towards the product surface to allow the meniscus to make a "meniscus jump" towards it. The viscosity and composition of the product will determine the size of gap between the product surface and the attraction feature and therefore the size of "meniscus jump" that the product surface will make.

[020] In an alternative embodiment the can / end are adapted, so that upon first opening (regardless of the headspace height / volume when the can was filled) the can / end accommodates a volume increase of the headspace and the can does not vent to the atmosphere until the end is lifted a predetermined height above the surface of the product. This may be achieved by providing a threaded can / end, in which the thread profile is modified to allow the end to be lifted relative to the can body before finally being unscrewed and the headspace vented to the atmosphere.

[021] This arrangement has several advantages. The can may be filled to conventional fill heights leaving a headspace, which is pressurised. During opening, a user simply unscrews the end. The thread profile is modified so that during unscrewing, the end is first raised relative to the can body without venting to atmosphere. This increases the volume of the headspace, thereby relieving some of the internal pressure in the can. Also, the height of the headspace is increased before the can is first opened (i.e. when the headspace gases vent to atmosphere) is raised. Both these effects minimise "spurting".

Brief Description of the Drawings

[022] FIGURE 1 shows a side section through a conventional food can having a non-easy open end (NOE), identifying the height of the headspace (h) at the point of first opening.

[023] FIGURE 2 shows a side section through a food can according to the invention having an attraction feature, which touches the surface of the product.

[024] FIGURE 3 shows an alternative embodiment according to the invention having an attraction feature, which is designed to approach but not touch the surface of the product, illustrating the "meniscus jump" principle.

[025] FIGURE 4 shows another embodiment according to the invention having an end with a stepped configuration, designed to provide improved strength.

[026] FIGURE 5 shows an exploded view of another embodiment according to the invention, having a can comprising body and a lid connected together by a modified screw thread and lug arrangement.

[027] FIGURE 6 shows a side view through of a portion of the can according to FIGURE 5, with the lid on the can body in its closed position (indicating the height of the headspace h).

[028] FIGURE 7 shows another side view through a portion of the can shown in FIGURES 5 and 6, with the lid on the can body in its partially open position (indicating the increased headspace height h').

[029] FIGURE 8 shows a magnified view of the screw thread arrangement used in the can according to FIGURES 5 to 7.

[030] FIGURE 9 shows a side view through a portion of the can according to another embodiment of the invention, with the lid on the can body in its closed position. In this embodiment, the can has a sliding o-ring style body seal.

[031] FIGURE 10 shows a side view through a portion of the can shown in FIGURE 9, with the lid in its partially open, raised position.

[032] FIGURE 11 shows a side view through a portion of the can according to another embodiment of the invention, with the lid on the can body in its closed position. In this

embodiment, the sliding seal is provided on the periphery of the lid.

[033] FIGURE 12 shows a side view through a portion of the can shown in FIGURE 11, with the lid in its partially open, raised position.

[034] For ease of reference, like features are designated using the same reference numerals throughout the drawings.

[035] Referring to Figure 1, a conventional food can 1 has a body 2 and at least one end 3, which is connected to the open end of the body 2 by a seam 4, normally a double seam. The food can 1 may either take the form of a 2-piece can, in which the body 2 is produced as a base end and integral side wall or a 3 piece can, in which the side wall takes the form of an open cylinder and separate ends are then seamed on to both ends of the cylindrical side wall. A base end is seamed to one of the open ends of the cylinder prior to filling with product 5 and thereafter the second, top end is seamed on to the other end of the cylindrical sidewall.

[036] The body 2 (comprising the sidewall and base) is filled with a product 5 to a predetermined fill height. Where the product 5 is liquid, the product surface 55 will form a meniscus, which is substantially flat. Due to surface tension effects, the product surface 55 will tend to creep up the sidewall of the body 2 to a point 52, where the product surface 55 adjoins the sidewall of the body 2. The free space between the product surface 55 and the end 3 is referred to as the headspace 7 and is filled with gas (normally air or an inert gas). In a pressurised food can, it is this headspace 7, which is pressurised.

[037] Now concentrating on the top end 3 of the can, the periphery of which is wrapped into the double seam 4 together with the open end of the body 2. Positioned radially inwardly of the seam 4, the end 3 has an inwardly concave reinforcing bead 6, which strengthens the end 3. Conventional tin openers pierce the can 1 either at the base of the reinforcing bead 6 or through the sidewall of the body 2, at the base of the seam 4.

[038] Considering a conventional tin opener which first pierces the can at the base of the reinforcing bead 6, the invention teaches that the headspace height h between the point of first opening (i.e. the point at which the tin opener first pierces the can) and the product surface 55 needs to be as large as possible, if "spurting" is to be avoided. However, it is also known that a large headspace volume is undesirable in a pressurised food can because a large headspace volume necessitates venting of a larger volume of gas before the pressure in the can reaches atmospheric pressure. A large headspace 7 is also perceived badly by consumers, who feel cheated by the fact that the can 1 is not as full as originally perceived. Thus, a compromise has to be reached between maximising the height h of the headspace 7, whilst controlling the overall volume of the headspace 7 in the can 1.

[039] Referring now to figure 2, a food can 1 according to the invention may also have a

body 2, end 3, seam 4 and reinforcing bead 6 configuration as described above. However, the can 1 is additionally provided with one or more attraction features 11, which draw the product 5 away from the point of first opening (at the base of the re-inforcing bead 6), thereby maintaining a clear headspace height h at this point. The attraction feature 11 comprises an indentation, which is sized and positioned such that it touches the surface 55 of the product 5. The product surface 55 is attracted to the attraction feature 11, by surface tension forces, thereby forming a meniscus with attraction points 51 and 52. This draws product 5 away from the point at which the can is first pierced (at the base of the reinforcing bead 6). The indentation (attraction feature 11) also has the benefit that it reduces the overall volume of the headspace 7, reducing the volume of pressurised gas that is vented when the can 1 is first opened.

[040] Figure 3 illustrates another embodiment of the invention, to which the principle of an attraction feature 11 has been applied. The food can 1 comprises a body 2 and an end 3, sealed together by a double seam 4. As previously described the can has a re-inforcing bead 6 and many conventional designs of tin opener are designed to first pierce the food can 1 at the base of this bead 6. The can 1 is filled with a product 5 to a predetermined height. A portion of the can end 3, spaced radially inwardly of the re-inforcing bead 6 is indented inwardly by a distance sufficient to approach closely but not touch the surface of the product 5. In this embodiment, the attraction feature 11 does not touch the surface 55 of the product 5, but approaches sufficiently closely that the attraction of the product surface 55 to the attraction feature 11 causes the product surface 55 to make a "meniscus jump" 50, bridging the gap between the product surface 55 and the lowest point of the attraction feature 11. This meniscus jump 50 draws an even greater volume of product 5 away from the point of first opening 6, ensuring that the headspace 7 is unobstructed at this point.

[041] Figure 4 illustrates another embodiment of a pressurised food can 1 to which this principle has been applied. The food can 1 comprises a body 2 and an end 3, sealed together by a double seam 4. Again the end has a reinforcing bead 6 and an indentation spaced radially inwardly thereof, which acts as an attraction feature 11. In this embodiment, the attraction feature 11 is formed by a series of indentations (beads) in the can end (3), which approximates the shape of a curve C. It is known from the manufacture of pressure vessels that a domed shape (either concave or convex) has the greatest strength for resisting pressure. Formation of a stable dome is difficult when using thin metal (as is the case in the manufacture of food cans). However, technology already exists for providing complex bead profiles in can ends and this technology can be applied to produce an end 3 having the profile shown in Figure 4. By adapting the shape and position of the steps, the indentation produced in the can end 3 can be made to approximate the curve C, giving the end 3 some of the strength benefits of a domed

end, whilst being easier and cheaper to produce from relatively thin metal at high speed.

[042] Figures 5 to 8 show a further embodiment of the invention, which is adapted to mitigate the effect of "spurting" when the can 1 is first opened. In this embodiment, the product fill height is less critical because the opening arrangement is designed to lift the end 3 relative to the body 2 before the can is allowed to vent for the first time. By lifting the end 3 on the body 2 during opening, the internal volume of the can 1 is increased and thereby, the internal pressure is reduced (as shown in Figures 6 and 7). Furthermore, the necessary height of the headspace at the point of first opening h' is created during the opening process (see Fig. 7).

[043] The can 1 may comprise a body 2 and a lid 3 connected together by a screw thread arrangement. The screw thread arrangement is modified, such that the lid 3 can lift a specified distance during unscrewing. This increases the internal volume of the can and thereby reduces the internal pressure thereof, without venting the gases in the headspace 7.

[044] Referring to Figure 8, the modified thread arrangement takes the form of a lug 43 carried on either one of the body 2 or lid 3 and one or more threads 42 carried on the other of the body 2 or the lid 3. In Figure 5 the lug 43 is shown carried on the lid 3 and a plurality of threads 42 are shown defined on the body 2.

[045] Referring to figure 8, the thread 42 takes a "z-shaped" form having two thread portions 421 interconnected by a vertical lift portion 422. The two thread portions 421 serve the same purpose as a conventional screw thread and the lift portion 422 is the substantially vertical portion of the thread 42, which allows the lid 3 to be lifted relative to the body 2, without venting the container. As shown in Figure 8, the vertical lift portion 422 may not be exactly vertical, but actually steeply sloped. The reason for this is that a vertical portion 422 would provide the desired lift, but the end 3 would tend to rise with a jolt, giving a shock to the user opening the container. Furthermore, this shock may result in displacement of the lug 43 from the thread 42. If the lug 43 is displaced from the thread 42, the lid 3 may be fired off the container with sufficient force to harm the user.

[046] It can also be seen from Figure 8 that the terminal ends of the thread portion 42 are shaped to provide a retaining feature 425. At the lower terminal end of the thread 42 (where the lug 43 is positioned when the lid 3 is fully closed), the retaining feature 425 retains the lug 43 and prevents over tightening of the lid 3 as it is screwed onto the body 2. At the upper terminal end of the thread (where the lug 43 is positioned just prior to the container being opened for the first time) the retaining feature 425 holds the lug 43 on the screw thread 42 and prevents the lid from being ejected from the container, prior to venting of the internal gases from the container.

[047] As shown in Figure 6, a seal is formed between the body 2 and lid 3 of the can using sealing compound 8. The sealing compound 8 forms a face seal 84 between the lid 3 and body 2 of the can. As the lid 3 is twisted, the lugs 43 rise up the slope on the thread 42 very quickly, before stopping at the retaining feature 425. The compound face seal 85 is broken, but as the volume expansion of the can occurs very quickly, the internal pressure is reduced before venting can occur. This effect greatly reduces the quantity of product 5 entrained in the subsequently venting gases.

[048] FIGURES 9 and 10 show an alternative embodiment of a screw can according to the invention. The thread / lug arrangement is the same as that shown in Figures 5 to 8. However, in this embodiment, the lid has a flared portion 35, which is of wider diameter than the remainder of the lid 3. The seal between the body 2 and lid 3 of the can is provided by a sliding body seal 85, which extends around the periphery of the open end of the body 2, The sliding body seal 85 prevents the can from venting until the lug 43 reaches the "open" end of the thread 42 and the lid 3 is lifted to the point at which the flared portion 35 passes the open end of the body 2. At this point any residual pressure in the can (remaining after the volume expansion caused by the lifting of the lid 2) may be vented to the atmosphere (as indicated by the arrows in FIGURE 10).

[049] FIGURES 11 and 12 show another embodiment of a screw can according to the invention. Again, the thread / lug arrangement is the same as that shown in Figures 5 to 10 and the lid has a flared portion 35, which is of wider diameter than the remainder of the lid 3 (as shown n Figures 9 and 10). A sliding lid seal 86 is provided to seal the body 2 and lid 3 of the can during opening. The sliding lid seal 86 is formed by inserting sealing compound around the inside of a portion of the top wall and sidewall of the lid 3 and prevents the can from venting until the lug 43 reaches the "open" end of the thread 42 and the lid 3 is lifted to the point at which the flared portion 35 passes the open end of the can body 2. At this point any residual pressure in the can (remaining after the volume expansion caused by the lifting of the lid 2) may be vented to the atmosphere (as indicated by the arrows in FIGURE 12).

[050] Although the screw thread / lug arrangement shown in Figures 5 to 12 allows the internal volume of the can to expand and thus some of the internal pressure to be relieved, it is still important that any residual overpressure in the can is allowed to vent safely to atmosphere, before the can is opened. Furthermore, although Figures 5 to 12 illustrate examples in which the thread arrangement comprises a thread 42 and a lug 43, arranged to ride along the thread 42, it will be appreciated by those skilled in the art that this could be replaced by a mutually co-operating screw thread arrangement or by some other system, which allows controlled increase in the volume / headspace of the container, whilst preventing uncontrolled venting.

[051] Finally, the lid (3) in the arrangements shown in figures 9 to 12 is described as having a flared portion 35. However, the man skilled in the art will understand that the flared portion on the lid may be replaced by a tapered section of the open end of the body. Alternatively, the thread arrangement may comprise an internal thread on the can body and the lid may take the form of a stopper. In this case, the flared section may be provided at the open end of the body, rather than on the cover.